

REMARKS

Claims 1-12 are pending in the present application. Claims 9-11 have been withdrawn from consideration by restriction. Reexamination of the application and reconsideration of the rejections and objections are respectfully requested in view of the following remarks, which follow the order set forth in the Office Action ("the Action").

Rejection of Claim 1 under 35 U.S.C. §103

Claims 1, 4, 7, and 12 were rejected under 35 USC §103 as being unpatentable over Huang et al., "Approaching theoretical capacity of LiFePO₄ at room temperature at high rates," Electrochemical and solid state letters, vol. 4, no. 10, October 2001 ("Huang") in view of Sumiya et al., U.S. 6,667,133 ("Sumiya"). Applicants respectfully traverse.

Claim 1 recites a process for preparing a carbon-coated, Li-containing olivine or NASICON powder. The process includes preparing a water-based solution including, as solutes, one or more Li-containing olivine or NASICON precursor compounds and one or more carbon-bearing monomer compounds. It further includes precipitating the Li-containing olivine or NASICON precursor compounds and polymerizing the monomer compounds in a single step. The process also includes heat treating the obtained precipitate in a neutral or reducing environment in order to form a Li-containing olivine or NASICON crystalline phase and decompose the polymer to carbon.

Huang discloses preparation of LiFePO₄/C composites using two methods, so-called methods A and B. *p. A170, ¶ 3*. Method A involves solid state mixing followed by firing. Specifically, three solid salts, CH₃COOLi, (CH₃COO)₂Fe, and NH₄H₂PO₄, are mixed together with a carbon gel, which is formed from the polymerization of resorcinol-formaldehyde. *p. A170, ¶ 3*. Importantly, such polymer formation takes place prior to the gel being mixed with any materials containing Li, Fe, or PO₄. Further, method A discloses no precipitation. Rather, method A discloses mixing salts in a solid state with a carbon gel. In this regard, Huang states that the organic precursor was chosen because it provided "a facile method of contacting the carbon with the solid state mixture." *p. A172, ¶ 1*.

Method B involves mixing surface oxidized carbon black with LiCl, FeCl₂·4H₂O, and H₃PO₄ in water. The water is then evaporated in an inert atmosphere, and the mixture is heat treated. Method B discloses no evaporation of water from a precipitated mixture at the claimed temperature. Further, method B discloses no polymerization whatsoever, much less

polymerization and precipitation in a single step. Thus, as admitted in the Office Action, Huang fails to teach precipitating the Li-containing olivine precursor compound and polymerizing the monomer compound in a single step as recited in claim 1.

The Office Action cites Sumiya for teaching that precipitation polymerization is used in the art that produces finely granular particles and that it may be used for forming gel with small particles. See, c. 9, ll. 4-29. The Office Action then states that it would have been obvious to use the teaching of precipitation polymerization in Sumiya in the process of Huang. Applicants respectfully disagree for at least the following reasons: 1) Applicants submit that after a fair reading of Sumiya, one of ordinary skill in the art would be unlikely to use the precipitation polymerization process for forming a polymer because the process is disclosed in an unfavorable light in Sumiya and is actually not used as the polymerization process in Sumiya, 2) one of ordinary skill in the art would have no reason to modify method A of Huang to incorporate precipitation polymerization because to do so would detrimentally alter method A, and 3) one of ordinary skill in the art would not include a precipitation polymerization step in method B because there is no polymerization step of any kind in method B and because surface oxidized carbon black does not polymerize.

Precipitation Polymerization is Disfavored in Sumiya

While Sumiya discloses that precipitation polymerization is a method of polymerization, it casts the precipitation polymerization process in an unfavorable light. For example, Sumiya discloses that precipitation polymerization is disfavored for forming a gel polymer with large particle size. See, c. 9, ll. 16-21. Sumiya further discloses that precipitation polymerization is generally carried out in a polar solvent such as aromatic hydrocarbons, alcohols, and the like and that the average polymerization degree of polymers polymerized in these solvents tends to be lowered and oligomers are easily formed. See, c. 9, ll. 31-37. Thus, one of ordinary skill in the art reviewing Sumiya would have no reason to use the precipitation polymerization method, which was disclosed in an unfavorable light therein, but rather would be more likely to use aqueous solution polymerization or reversed phase suspension polymerization, which were actually used as polymerization methods in Sumiya.

Precipitation Polymerization Would Detrimentially Alter Method A of Huang

In method A of Huang, resorcinol-formaldehyde (RF) is polymerized to form an RF-gel polymer and then CH_3COOLi , $(\text{CH}_3\text{COO})_2\text{Fe}$, and $\text{NH}_4\text{H}_2\text{PO}_4$ salts are mixed with the RF-gel polymer. The four compounds - Li- and Fe- acetate crystals, solid ammonium phosphate, and RF-gel polymer - are all mixed together in solid form after the RF-gel polymer has formed and any water has been removed therefrom. In fact, Huang discloses that the RF-gel polymer is washed with acetone twice prior to use to extract water and any carbonate impurities. See, p. A170, ¶3. Based on the disclosure of method A, it appears important that no water be present in the RF-gel polymer when it is mixed with the Li- and Fe- acetate crystals and the solid ammonium phosphate. In contrast, claim 1 recites that a water-based solution is prepared and that precipitation and polymerization occur from the water-based solution. Further, Sumiya discloses that precipitation polymerization is generally carried out in a polar solvent. See, c. 9, ll. 31-37. Thus, it seems necessary that some form of solvent be present in order for precipitation polymerization to take place. However, there is absolutely no solvent whatsoever in method A of Huang. Further, it appears that the addition of any solvent to method A would be harmful to the process. Based on the foregoing, one of ordinary skill in the art would have no reason to modify method A of Huang by adding a solvent in order to incorporate precipitation polymerization because to do so would detrimentally alter method A.

Method B has no polymerization step

In method B of Huang, there is no polymerization taking place at all. Thus, one of skill in the art would have no reason to add an extra, needless step that would likely detrimentally alter the process. In fact, given the compounds used in method B, the step of polymerizing the carbon-bearing monomer, as recited in claim 1, actually cannot take place in method B. In method B, surface oxidized carbon black is mixed with LiCl , $\text{FeCl}_2 \cdot 4\text{H}_2\text{O}$, and H_3PO_4 in water. The surface of the carbon black is oxidized by spraying it with $\text{HNO}_3/\text{H}_2\text{SO}_4$. The acid that is sprayed on the surface changes the inherent surface chemistry of the carbon black. While surface oxidation enhances performance characteristics of the carbon black, it is impossible to polymerize surface oxidized carbon black, even when it has a carboxylic moiety, such as the surface oxidized carbon black in method B of Huang.

Given that there is no polymerization step in method B and that surface oxidized carbon black does not polymerize, Applicants submit that even if Sumiya teaches

precipitation polymerization, one of ordinary skill in the art would have no reason to combine such teaching with method B of Huang. Based on the foregoing, Applicants respectfully request reconsideration and withdrawal of the instant rejection.

Additional §103 Rejections

Claims 2 and 3 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Huang in view of WO 2002/027823 to Armand et al. ("Armand"). Applicants traverse this rejection. As discussed in detail above, Huang discloses preparation of LiFePO_4/C composites using two different methods. Neither method discloses precipitation of a precursor compound of any sort. Further, Huang fails to teach or suggest a process wherein precipitating and polymerizing occur in a single step as required in claim 1.

Armand discloses a method of synthesizing compounds of the formula $\text{C-Li}_x\text{M}_{1-y}\text{M}'_y(\text{XO}_4)_n$ wherein: x , y , and n represent numbers such that $0 \leq x \leq 2$, $0 \leq y \leq 0.6$, and $1 \leq n \leq 1.5$; M is a transition metal or a mixture of transition metals of the first line of the periodic table; M' is an element with fixed valency selected among Mg^{2+} , Ca^{2+} , Al^{3+} , Zn^{2+} , or a combination of said elements; and X is selected among S, P, and Si. Armand fails to disclose or suggest x being 1, 2, or 3 or X being P_{x-1}S_x with $0 \leq x \leq 1$ as recited in claim 2. Rather, Armand teaches a composition wherein Li may or may not be present and X is selected from S, P, and Si. In contrast, Li is a required element in the recited crystalline phase of claim 2. Armand fails to disclose or reasonably suggest to one of ordinary skill in the art a composition wherein Li is required and wherein X is a combination of elements as recited in claim 2. Further, combining the disclosure of Armand with the disclosure of Huang fails to overcome the deficiencies present in the Huang reference because Armand fails to disclose or reasonably suggest precipitation and polymerization in a single step. As such, Applicants assert that Huang in combination with Armand fails to make obvious the invention of claim 2, and thus necessarily claim 3, which depends from claim 2. Accordingly, Applicants respectfully request reconsideration and withdrawal of the instant rejection.

Claims 5-8 are rejected under 35 U.S.C. §103(a) as being allegedly unpatentable over Huang in view of Pechini, U.S. Patent No. 3,330,697 ("Pechini") and Tietz et al., WO 02/44103 ("Tietz"). Additionally, claim 8 was rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Huang in view of WO 2002/099913 to Wurm et al. ("Wurm"). Applicants traverse these rejections.

As discussed in detail above, Huang discloses preparation of LiFePO_4/C composites using two different methods. Neither method discloses precipitation of a precursor compound of any sort. Further, Huang fails to teach or suggest a process wherein precipitating and polymerizing occur in a single step as required in claim 1. Combining the disclosures of Pechini, Tietz, and Wurm with the disclosure of Huang fails to overcome the deficiencies present in the Huang reference because these references also fail to disclose a process wherein precipitation and polymerization occur in a single step. As such, Applicants assert that Huang in combination with Pechini, Tietz, and/or Wurm fails to make obvious the inventions of claims 5- 8. Accordingly, Applicants respectfully request reconsideration and withdrawal of the instant rejection.

For the foregoing reasons, independent claim 1 and claims 2-8 and 12, depending therefrom, are considered to be allowable. A Notice to this effect is respectfully requested. If any questions remain, the Examiner is invited to contact the undersigned at the number given below.

Respectfully submitted,

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